Appendix J

Estimating the Cost of Rail Hauling Municipal Solid Waste

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Prepared for King County

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INTRODUCTION

HDR Engineering, Inc. ("HDR") developed a rail transport economic model (the "Railhaul Cost Model") to estimate the cost of transporting municipal solid waste ("MSW") by rail from an intermodal transfer station to a remote landfill or other disposal destination. As part of the recent New York City solid waste management planning effort, HDR developed this Excel™ spreadsheet model to evaluate alternative waste export options, including estimating the potential transportation costs of hauling MSW by rail from New York City to landfills in the southeast United States. HDR adapted the Railhaul Cost Model to estimate railhaul costs from King County to landfills in Arlington, Washington and Boise, Idaho.

HDR obtained the input parameters from several sources as noted in the tables below. HDR gathered information from rail professionals that is listed as 'HDR files'. Sources listed as 'Railroads' indicate data gathered by HDR from various railroad companies, including Burlington Northern Santa Fe (BNSF), Union Pacific Railroad (UPRR), and CSXT Corporation. HDR gathered equipment information from sources listed as 'Manufacturers'.

The methodology and input parameters used in the Rail Cost Model are presented in the following sections. A discussion of the various scenarios modeled by HDR follows. The objective of these scenarios was to define a range of costs (i.e., upper and lower bounds). The results of the model runs are presented in a table that gives annual and per-ton costs.

GENERAL METHODOLOGY AND INPUT PARAMETERS

The model uses various input parameters to approximate the cost of rail transport. The model calculates the number of required train sets that is based on the time required to travel from the intermodal facility to the disposal site(s), the annual tonnage of MSW transferred at the intermodal facility and the tonnage capacity of each train. Each train set consists of the locomotives, railcars, and containers. The model then calculates the capital investment required to purchase this rail equipment.

Operation and maintenance costs, based on train set days, are developed and include the labor (train crews) and equipment maintenance necessary for the transport operation. A corporate profit, calculated as a percentage of total operating and maintenance costs, is also included in the railhaul costs. It is assumed that profits are not added to equipment leasing (or purchasing, rather a rate of return is implicit in the assumed cost of capital.

Each scenario is defined by the case-specific input parameters. Key input parameters used to estimate the railhaul costs for King County are given below:

Waste Stream Projections

Parameter	Amount	Unit	Source
Annual tonnage of MSW (2012)	1,098,500	Tons	King County
Annual tonnage of MSW (2030)	1,250,000	Tons	King County
Available days/year (Facility)	312	Days	King County
Avg. load per container (Compacted on-site)	35	Tons	King County
Avg. load per container (Compacted off-site)	27	Tons	King County

Rail Operations

Parameter	Amount	Unit	Source
Available days/year	312	Days	Railroads
Cycle time (Arlington)	3	Days	Railroads
Cycle time (Boise)	6	Days	Railroads
Maximum unit train length	6000	Feet	Railroads
Containers per railcar	2		Railroads
Shift crew size	2		Railroads
Road crews required	4		Railroads
Fuel consumption	8	gallons/hour/unit	Railroads
Fuel consumption	3	miles/gallon	Railroads

Disposal Site

Parameter	Amount	Unit	Source
Round trip mileage (Arlington)	626	Miles	Railroads
Round trip mileage (Boise)	1336	Miles	Railroads

Equipment

Parameter	Amount	Unit	Source
Container tare weight	3.75	Tons	Manufacturers
Railcar weight	27	Tons	Manufacturers
Railcar length	71.67	Feet	Manufacturers
Locomotive length	75	Feet	Manufacturers
Maintenance locomotive	1.0%		Manufacturers
Maintenance railcars	1.5%		Railroads
Maintenance containers	2.0%		Railroads
Spare locomotive multiplier	10%		Railroads
Spare flatcar multiplier	30%		Railroads
Spare container assumption	2	Per railcar spare	Railroads
Number of locomotives per train set (Arlington & Boise and < 5800 trailing tons)	3		Railroads
Number of locomotives per train set (Boise and > 5800 trailing tons)	4		Railroads

Costs/Financing

Parameter	Amount	Unit	Source
Crew cost per day (each)	$500		Railroads
Railroad markup	15%		Railroads
Fuel cost	$.90	dollars/gallon	HDR Files
Term of loan	20	years	HDR Files
Interest rate	8.00%		HDR Files
Unit train efficiency savings	-5%		Railroads
Switching - unit train assembly costs	$50	per railcar	Railroads
Cost per container	$10,000		Manufacturers
Cost per railcar	$55,000		Manufacturers
Cost per locomotive	$2,000,000		Manufacturers

The major assumptions used in the analysis are:

- The two "average tons per container" parameters (i.e., 27 and 35 tons) reflect the two alternatives (with or without compaction on-site) that King County is considering;

- The train cycle time is the number of days required for a train to be assembled at the intermodal facility or switchyard, hauled to the disposal site, unloaded at the disposal site, and returned to the intermodal facility; and
- Multiple train sets may be required to ensure continuous operation takes place at the intermodal facility. In other words, while one or more train sets are being hauled to the disposal site, another train set is being assembled at the intermodal facility.

The maintenance and equipment spares input parameters reflect typical railroad industry percentages that allow for sufficient slack in the system for regular maintenance and unplanned break-downs. The unit train efficiency factor represents the cost advantages that the railroad expects to realize if the MSW is transported in full unit trains rather than being integrated with other freight traffic.

The capital costs include the cost of the locomotives, railcars, and containers. Dollars are in 2003 real values. HDR assumed that the railroad would purchase or lease this equipment at an effective 8% interest rate. This reflects a blend of debt and equity.

SCENARIOS MODELED

HDR developed eight (A-H) scenarios for the first and last years (2012 and 2030) of the planning horizon, which produced 16 total scenarios. The two years were chosen to account for increased growth in King County and the resulting increase in MSW generated. The following are the scenarios simulated for both 2012 and 2030:

Scenario	Disposal Site	Train Departure Schedule	Tons per Container
A	Arlington	Daily	27
B	Arlington	Only When Full	27
C	Arlington	Daily	35
D	Arlington	Only When Full	35
E	Boise	Daily	27
F	Boise	Only When Full	27
G	Boise	Daily	35
H	Boise	Only When Full	35

The term “only when full” when referring to the train schedule refers to a scenario where a train is kept at the facility until the maximum amount of railcars have been assembled. The maximum train length for all scenarios modeled was determined to be 6000 feet that provides for 80 or 81 railcars, depending on whether a fourth locomotive is required. A fourth locomotive is required for the haul to Boise, if the trailing weight is greater than 5800 tons. Since an additional locomotive is required, the train must have one less railcar (80).

As part of this project, HDR did not run railhaul simulations that consider the impact of any number of train dispatch schedule constraints. However, HDR selected two dispatching scenarios, the "daily" and "only when full" scenarios, that are likely the upper and lower bounds, respectively, of the cost impacts of any such dispatch schedule constraints.

RESULTS

The estimated railhaul costs of transporting MSW from the intermodal site to the two landfills for various assumptions are presented in the following tables:

Destination: Arlington

Train Leaving Daily				
	Year 2012		Year 2030	
	27 tons/cont	35 tons/cont	27 tons/cont	35 tons/cont
Per ton	$8.63	$7.75	$8.07	$7.14
Per year	$9,480,000	$8,520,000	$10,100,000	$8,930,000

Train Leaving Only When Full				
	Year 2012		Year 2030	
	27 tons/cont	35 tons/cont	27 tons/cont	35 tons/cont
Per ton	$8.61	$6.24	$8.07	$7.13
Per year	$9,460,000	$6,850,000	$10,100,000	$8,910,000

Destination: Boise, Idaho

Train Leaving Daily				
	Year 2012		Year 2030	
	27 tons/cont	35 tons/cont	27 tons/cont	35 tons/cont
Per ton	$13.86	$12.55	$14.16	$12.77
Per year	$15,200,000	$13,800,000	$17,700,000	$16,000,000

Train Leaving Only When Full				
	Year 2012		Year 2030	
	27 tons/cont	35 tons/cont	27 tons/cont	35 tons/cont
Per ton	$13.68	$10.87	$14.24	$11.47
Per year	$15,000,000	$11,900,000	$17,800,000	$14,300,000

There are several variables that drive the results outlined above:

- Increased travel time (or distance) to the disposal locations increases costs of operation, maintenance and equipment necessary (due to increased number of train sets);
- Increased compaction of MSW results in a decreased per-ton cost of transport, due to the greater efficiency of hauling more waste on each train; and
- Costs would be reduced for the scenarios where trains leave only when full. This is again the result of increased amounts of waste being hauled during each train trip, thereby decreasing the total number of train sets required.

The costs are not linearly related between the 27-ton per container and 35-ton per container scenarios. Non-linearity results from the occurrences of thresholds for determining when additional train sets are required. The additional train set may be underutilized, though it would still be necessary to have the equipment on-hand for continuous operations.

Finally, it is important to also note that the results above calculate only the rail transport costs for a generic set of scenarios. Market conditions including the competition among railroad companies will affect the actual cost of railhauling MSW.